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ORIGINS OF CHINOOK SALMON (Oncorhynchus tschawytscha Walbaum)
IN THE YUKON RIVER FISHERIES, 1985

By:

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August 1986

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Don W. Collinsworth
Commissioner

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ABSTRACT

Analysis of scale patterns and age composition of chinook salmon *(Oncorhynchus tschawytscha* Walbaum) from Yukon River catches and escapements was used to apportion the lower Yukon River District 1, 2, and 3 commercial harvests to geographic region (run) of origin. A similar apportionment of subsistence harvests was made. Other Yukon River chinook salmon harvests were apportioned primarily be geographical area of occurrence. Run contribution to total Yukon River utilization was estimated at 101,542 (49.5%) upper Yukon, 63,348 (30.9%) lower Yukon, and 40,028 (19.5%) middle Yukon fish. The fraction of the Districts 1 and 2 commercial catch apportioned to the lower Yukon generally increased during the period of the analysis while the fraction apportioned to the upper Yukon generally declined.

INTRODUCTION

Yukon River chinook salmon *(Oncorhynchus tschawytscha* Walbaum*)* are harvested
in a wide range of fisheries in both marine and fresh waters. During their
ocean residence, they are harvested in salmon gillnet fisheries in the North
Pacific Ocean and Bering Sea and in trawl fisheries in the Bering Sea. Upon
returning to the Yukon River as adults, they are harvested in a variety of
commercial and subsistence fisheries in both Alaska and Canada (Figures 1 and
2).

A major controversy currently facing managers of Yukon River chinook salmon
is allocation of the harvest among the various user groups. Two such alloca-
tion issues which have recently received considerable public attention are:
(1) high seas interceptions of North American chinook salmon (including fish
destined for the Yukon River) in the gillnet and trawl fisheries in the North
Pacific Ocean and Bering Sea; and (2) negotiations between the United States
and Canada over inriver harvest of chinook salmon destined for Canadian por-
tions of the Yukon River drainage.

Identification of stock groupings and estimation of their contribution rates
is becoming an increasingly important facet of Yukon River chinook salmon
management. Contribution estimates of Western Alaska/Canadian Yukon Territory
chinook salmon, recently estimated for the Japanese high seas gillnet fisher-
ies (Rogers et al. 1984, Meyers et al. 1984, Meyers and Rogers 1985), have
become major elements in the regulation of these ocean fisheries. Concurrent
with offshore studies, stock composition of inriver fisheries has been studied
to provide useful information for resource administrators making inriver allo-
cation decisions and managers seeking to improve management precision through
a better understanding of stock-specific production units and their spatial/
temporal migratory patterns. Stock composition estimates through time for
Yukon River chinook salmon became available in 1980 and 1981 when the feasi-
bility of apportioning catches using scale pattern analysis for District 1
catches was initially investigated (McBride and Marshall 1983). Since then,
the entire drainage harvest has been apportioned annually to geographic region
of origin (Wilcock and McBride 1983, Wilcock 1984, Wilcock 1985).

The Yukon River combined commercial and subsistence chinook salmon fishery is
one of the largest in Alaska, averaging 17% of statewide chinook salmon har-
vest annually (1980-1984). In the first 20 years after statehood (1960-1979),
combined Alaskan and Canadian Yukon River chinook salmon harvest averaged
122,971 fish annually. However, catches in recent years have increased sub-
stantially (1980-1984 average 197,662 fish). While chinook salmon are har-
vested virtually throughout the entire length of the Yukon River, the majority
of the catch is taken in commercial gillnet fisheries in Districts 1 and 2
(1980-1984 average 66% of total drainage harvest). Subsistence harvests,
including Canadian catches, account for another 24% (1980-1984 average) of
the total harvest. Most of the subsistence harvest is taken with fishwheels
and gill nets in Districts 4, 5, and 6. In 1985, commercial and subsistence
fishermen in Alaska and Canada harvested a total of 204,960 chinook salmon,
of which 138,376 fish (68%) were taken by District 1 and 2 commercial fisher-
men.
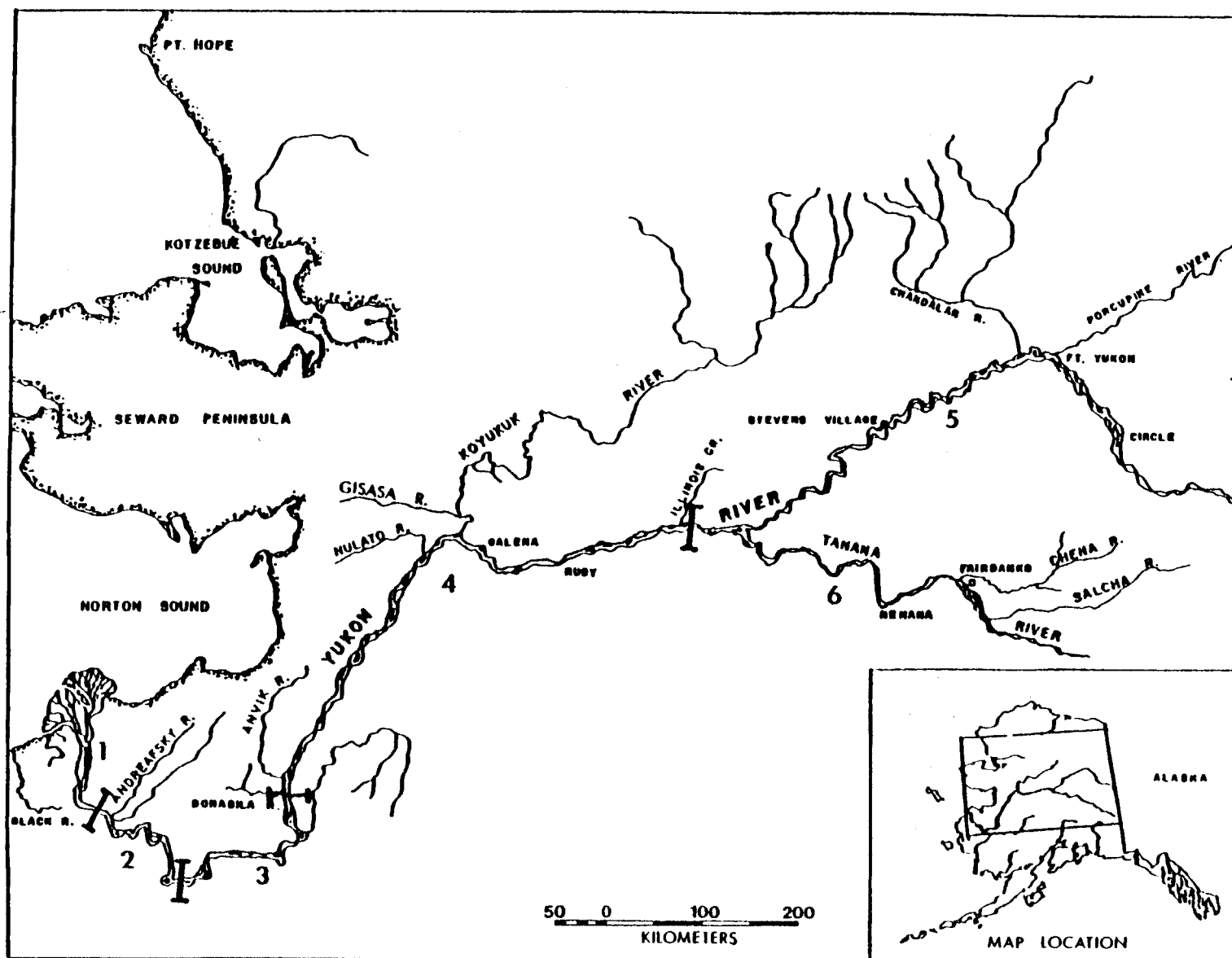
Figure 1. Alaskan portion of the Yukon River showing the six regulatory districts.
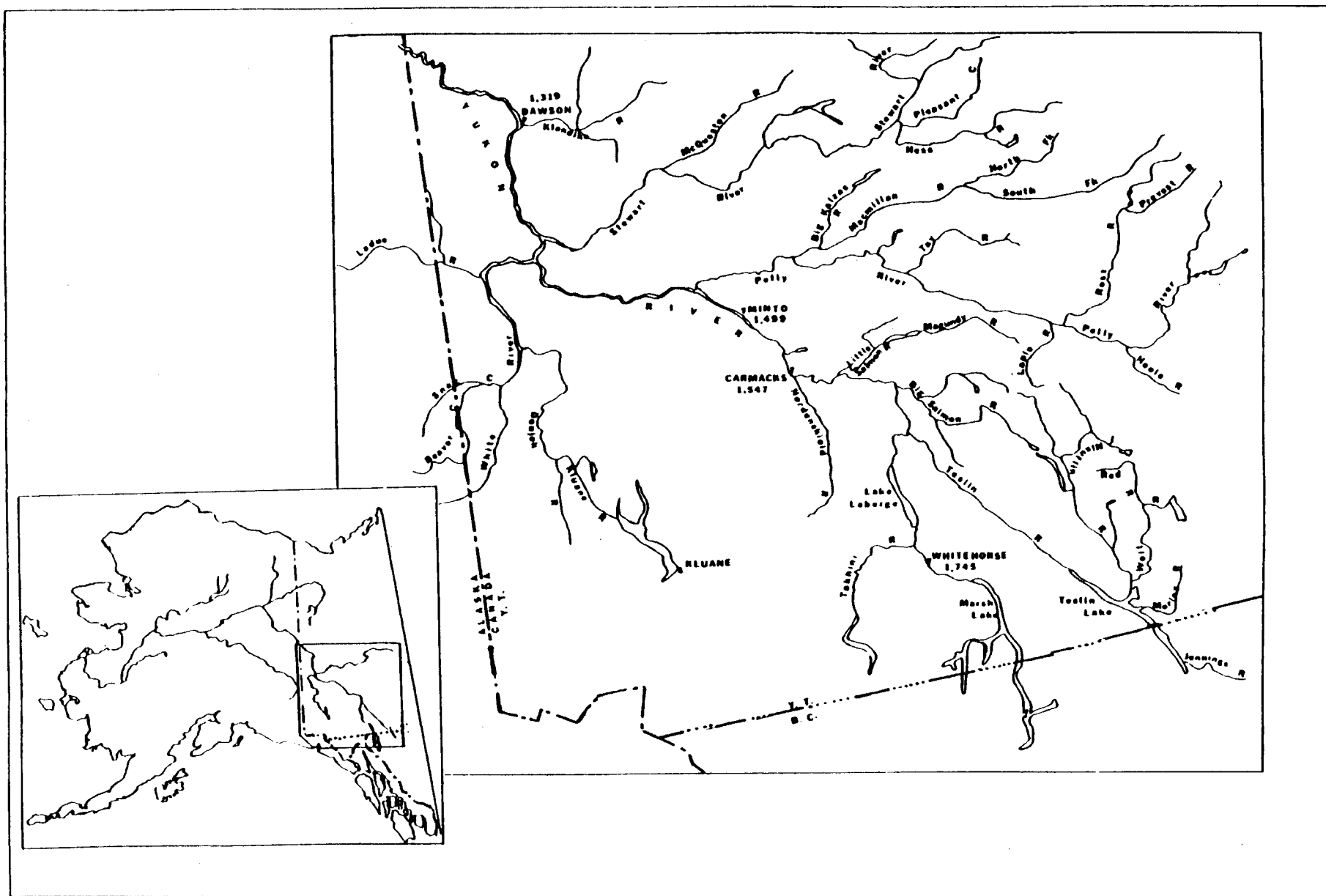
Figure 2.   Canadian portion of the Yukon River.

Chinook salmon harvested in the Yukon River fisheries consist of a mixture of stocks destined for spawning areas throughout the Yukon River drainage. Although more than 100 spawning streams have been documented (Barton 1984), aerial surveys of chinook salmon escapements indicate that the largest concentrations of spawners occur in three distinct geographic regions: (1) tributary streams that drain the Andreafsky Hills and Kaltag Mountains between river miles 100 and 500; (2) Tanana River tributaries between river miles 800 and 1,100; and (3) tributary streams that drain the Pelly and Big Salmon Mountains between river miles 1,300 and 1,800. Chinook salmon stocks within these geographic regions have been termed runs (McBride and Marshall 1983) and defined as the lower, middle, and upper Yukon runs, respectively.

This report builds upon the catch, escapement, and age composition database compiled by Buklis and Wilcock (in prep.) for the 1985 return of salmon to the Yukon River. The objective is to apportion the 1985 Yukon River chinook salmon commercial and subsistence harvest to run of origin. Procedures and analyses used to apportion individual fisheries are illustrated in Figure 3. Commercial catches from Districts 1, 2, and 3 were allocated to run of origin by analysis of scale patterns of age 1.4 and 1.3 fish[1], and catch and escapement age composition data. Estimates of the contribution by run in commercial catches were applied to subsistence catches from these districts. Commercial and subsistence catches from Districts 5 and 6, and the Yukon Territory were allocated based on geography. Pooled commercial and subsistence catches from District 4 were allocated based on geography, scale pattern analysis of age 1.4 and 1.3 fish, and catch and escapement age composition data.

METHODS

Age Composition

Scale samples provided age information for fish in the catch and escapement. Samples were collected on the left side of the fish approximately two rows above the lateral line and on the diagonal row downward from the posterior insertion of the dorsal fin (Clutter and Whitesel 1956). Scales were mounted on gummed cards and impressions made in cellulose acetate.

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[1] European formula: the first numeral refers to the number of freshwater annuli present on scales of the fish and represents the number of years of freshwater residence minus one (freshwater residence prior to scale formation). The second number refers to the marine age of the fish. Total age is the arithmetic sum of these two numbers plus one.

```
**************************
**    TOTAL  YUKON      **
**   RIVER  HARVEST     **
**************************
```

```
: Alaskan Harvest :                                              : Canadian Harvest :
```

```
: Districts :    : District :    : District :    : District :    : District :    : Yukon      :
:   1 & 2   :    :    3     :    :    4     :    :    5     :    :    6     :    : Territory  :
```

```
: Subsistence : : Commercial :  : Subsistence : : Commercial :  : MAINSTEM     :  : KOYUKUK R. :  : Commercial & :  : Subsistence : : Commercial :  : Subsistence : : Commercial :
                                                                : Commercial & :  : Subsistence :  : Subsistence :
                                                                : Subsistence  :
```

```
      :    AGE      :              :    AGE      :              :    AGE      :              :    AGE      :              :    AGE      :              :    AGE      :
      : COMPOSITION :              : COMPOSITION :              : COMPOSITION :              : COMPOSITION :              : COMPOSITION :              : COMPOSITION :
```

```
  : Age     :  : All Othe :      : Age     :  : All Other :    : Age     :  : All Other :
  : 62 & 52 :  :   Ages   :      : 62 & 52 :  :   Ages    :    : 62 & 52 :  :   Ages    :
```

```
     by          season          season          season          season          season
  fishing        total           total           total           total           total
   period
```

```
 : SCALE    :  : DIFFERENTIAL :   : SCALE    :  : DIFFERENTIAL :   : SCALE    :  : DIFFERENTIAL :   : GEOGRAPHIC :   : GEOGRAPHIC :              : GEOGRAPHIC :              : GEOGRAPHIC :
 : PATTERNS :  : AGE          :   : PATTERNS :  : AGE          :   : PATTERNS :  : AGE          :   : ANALYSIS   :   : ANALYSIS   :              : ANALYSIS   :              : ANALYSIS   :
 : ANALYSIS :  : ANALYSIS     :   : ANALYSIS :  : ANALYSIS     :   : ANALYSIS :  : ANALYSIS     :
```

```
      Allocation                   Allocation                   Allocation         Allocation     Allocation                   Allocation                   Allocation
      : LOWER :                     : LOWER :                     : LOWER :          : MIDDLE :     : UPPER :                     : MIDDLE :                     : UPPER :
      : ---   :                     : ---   :                     : ---   :
      : MIDDLE:                     : MIDDLE:                     : MIDDLE:
      : ---   :                     : ---   :                     : ---   :
      : UPPER :                     : UPPER :                     : UPPER :
```

```
Assume                      Assume                      Assume                                                  Assume              Assume
Identical                   Identical                   Identical                                               Identical           Identical
Age & Run                   Age & Run                   Age & Run                                               Age & Run           Age & Run
Structure                   Structure                   Structure                                               Structure           Structure
```

```
: SEASON TOTAL :   : SEASON TOTAL :   : SEASON TOTAL :   : SEASON TOTAL :  : SEASON TOTAL :   : SEASON TOTAL :   : SEASON TOTAL :
:      by      :   :      by      :   :      by      :   :              :  :      by      :   :      by      :   :      by      :
:  age & run   :   :  age & run   :   :  age & run   :   :   by run     :  :  age & run   :   :  age & run   :   :  age & run   :
```
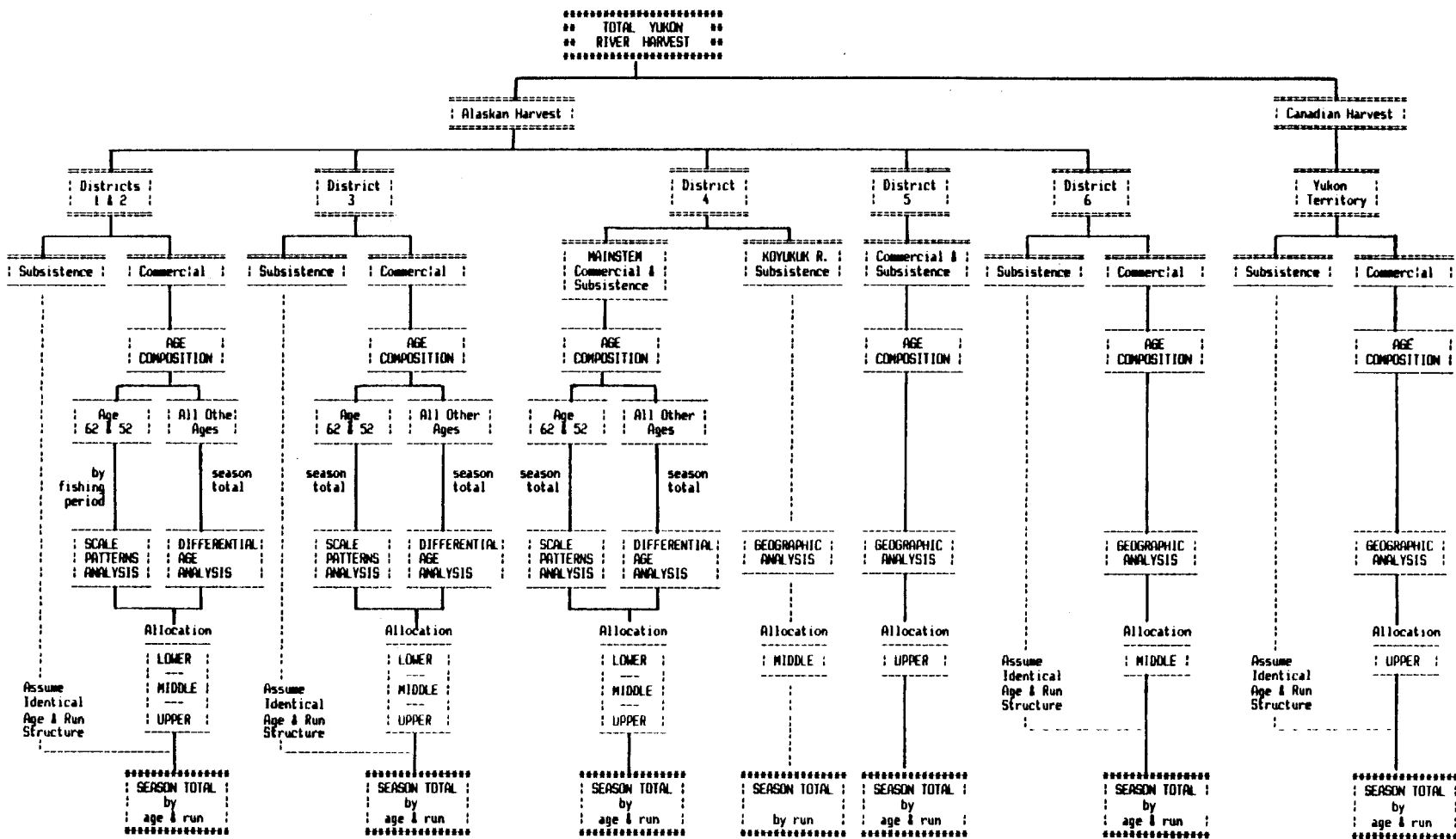
Figure 3. Schematic representation of analyses used to allocate Yukon River chinook
salmon harvest by age class and run of origin, 1985.

Catch:

Scales were collected[1] from the commercial catches from Districts 1, 2, 3, and 6, and Yukon Territory and an age composition was estimated for each fishery. Although subsistence catches in these districts were not sampled, subsistence fishing occurred concurrently with commercial effort and the age composition for subsistence catches in each district were assumed to be similar to the commercial catch.

Samples were also collected from commercial and subsistence catches in Districts 4 and 5. For each of these districts, pooled age compositions were estimated for the combined commercial and subsistence catches from both fishwheels and gill nets.

Escapement:

Scale samples were collected during peak spawner die-off from the major spawning tributaries (as determined by aerial surveys). Virtually all samples were collected from carcasses. The age composition of lower, middle, and upper Yukon areas was estimated by weighting the age composition calculated for the individual spawning tributaries in each area by the escapement to each tributary as indexed by aerial surveys.

Catch Apportionment

Linear discriminant function analysis (Fisher 1936) of scale pattern data and observed differences in age composition between escapements were used to allocate 1985 Yukon River chinook salmon catches to run of origin.

Scale Pattern Analysis:

Escapement samples and Yukon Territory commercial catch samples provided scales of known origin that were used to build linear discriminant functions (LDF). Commercial catch and test fishing[2] samples provided scales of mixed stock composition which were classified using the discriminant functions to estimate proportions of lower, middle, and upper Yukon ages 1.4 and 1.3 fish in the District 1, 2, 3, and 4 catches. Subsistence catch samples were included in mixed stock composition samples for District 4.

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[1] Sampling of Alaskan fisheries was conducted by Alaska Department of Fish and Game staff, Division of Commercial Fisheries. Sampling of Canadian fisheries was conducted by Canadian Department of Fisheries and Oceans staff.

[2] ADF&G conducts test fishing projects in Yukon River Districts 1 and 4 to index the timing and magnitude of salmon migrating along the Yukon River. Test fishing is conducted concurrently with the commercial fishery and samples collected from these projects represent fish of mixed stock composition.

Model Construction. Measurements of scale features were made as described by McBride and Marshall (1983). Scale images were projected at 100X magnification using equipment similar to that described by Ryan and Christie (1976) and measurements were made and recorded by a microcomputer-controlled digitizing system. Measurements were taken along an axis approximately perpendicular to the scuptured field and the distance between each circulus in each of three scale growth zones (Figure 4) was recorded. The three zones were: (1) scale focus to the outside edge of the freshwater annulus (first freshwater annular zone), (2) outside edge of the freshwater annulus to the last circulus of freshwater growth (freshwater plus growth zone), and (3) the last circulus of the freshwater plus growth zone to the outer edge of the first ocean annulus (first marine annular zone). In addition, the total width of successive scale pattern zones was also measured for: (1) the last circulus of the first ocean annulus to the last circulus of the second ocean annulus (ages 1.4 and 1.3), and (2) the last circulus of the second ocean annulus to the last circulus of the third ocean annulus (age 1.4 only). Seventy-nine scale characters (Appendix Table 1) were calculated from the basic incremental distances and circuli counts.

Scale samples (standards) representing the three Yukon chinook salmon runs were constructed for the 1.4 and 1.3 age classes. Because of limited sample sizes, all available age 1.4 and 1.3 samples representing the lower Yukon (the Andreafsky and Anvik Rivers) and age 1.3 scales representing the middle Yukon (the Chena and Salcha Rivers) were used. Age 1.4 scales representing the middle Yukon run were selected in proportion to their abundance as indicated by aerial surveys.

Scales representing the upper Yukon run included all available Yukon Territory commercial catch samples. These samples were considered to be the most representative composite available for upper Yukon escapements. Because of small sample sizes for the age 1.3 age class, all samples from individual escapements were included.

Classification. Linear discriminant functions (LDF) were calculated for each age class. Selection of scale characters for each analysis was by a forward stepping procedure using partial F statistics as the criteria for entry/deletion of variables (Enslein et al. 1977). A nearly unbiased estimate of classification accuracy for each LDF was determined using a leaving-one-out procedure (Lachenbruch 1967).

Contribution rates for ages 1.4 and 1.3 fish in the District 1 and 2 catches were estimated for each fishing period during the chinook salmon season and a pooled sample for the chum salmon season[1]. A total season contribution rate

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[1] Most of the chinook salmon harvested in these two districts are taken by a directed fishery that commences in early June when mostly gill nets of 203 to 229 mm (8 to 9 inch) stretched mesh are operated. This June fishery is commonly referred to as the "early" or "chinook" season. During this fishery, there are no gillnet mesh size restrictions and most fishermen operate large mesh nets for chinook salmon. However, some nets of 140 to 152 mm (5-1/2 - 6 inch) stretched mesh are also operated. The remaining harvest is taken incidentally to the chum (O. keta) and coho (O. kisutch) salmon fishery. This fishery, in which gill nets of up to 152 mm (6 inch) stretched mesh are allowed, commences in late June or early July.
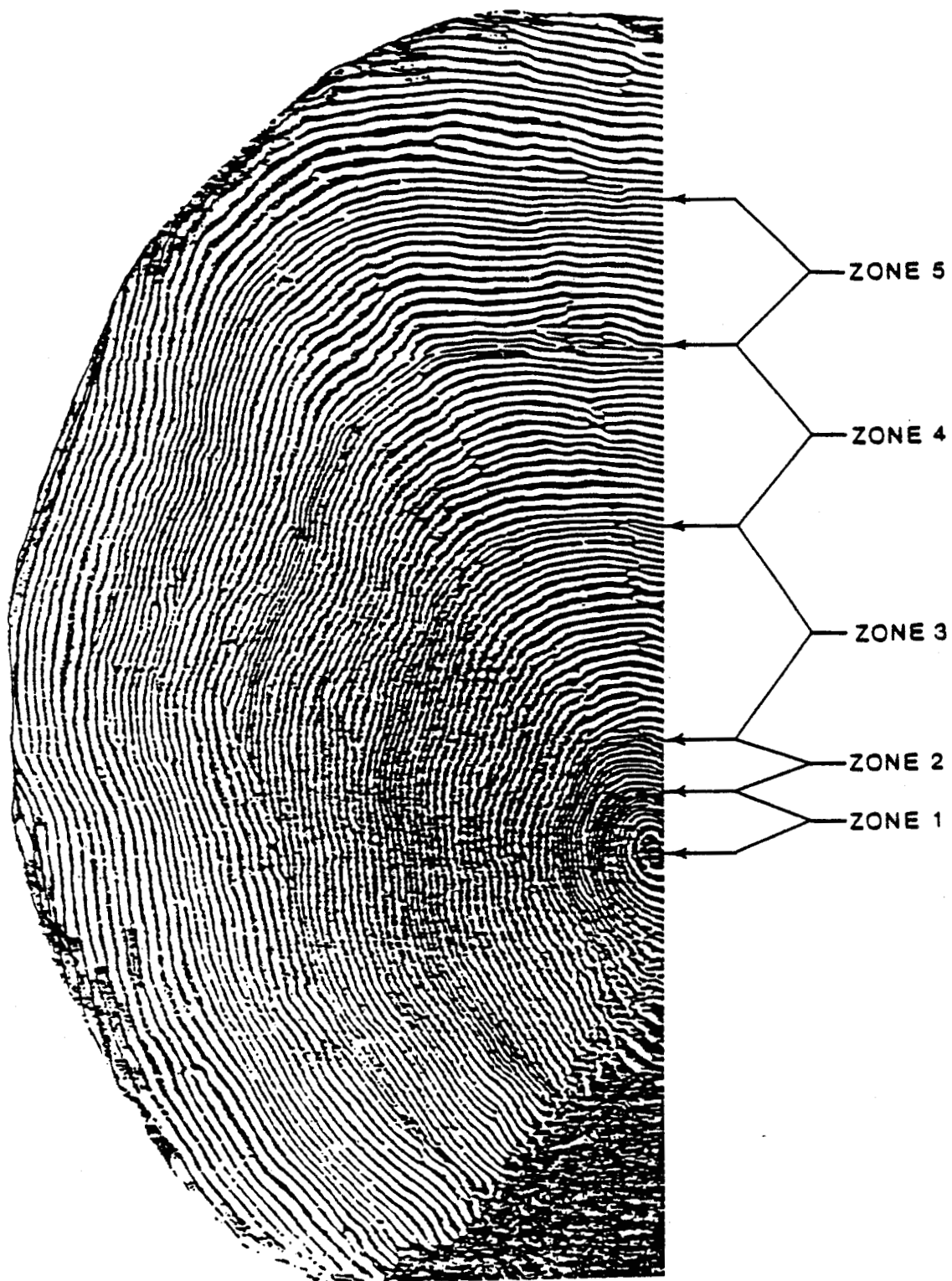
Figure 4. Age 1.4 chinook salmon scale showing zones measured for linear discriminant analysis.

for the District 3 catch was estimated from a sample collected during the second fishing period. Contribution rates for the combined commercial and subsistence harvests in District 4 were estimated from samples collected from both fisheries (including both gillnet and fishwheel gear types) during most of the season. Point estimates were adjusted for misclassification errors using the procedure of Cook and Lord (1978). The variance and 90% confidence intervals for these estimates were computed using the procedures of Pella and Robertson (1979).

A catch sample was reclassified with a model representing only two runs if the final proportional estimate was less than or equal to zero for any run. A two-way model was constructed using only standards from the two runs with positive classification estimates. Data were resubmitted to the variable selection routines and a new subset of variables was chosen for inclusion in the two-way model.

Results of the age-specific scale pattern analysis were summed to estimate total contribution by run of origin for age 1.4 and 1.3 chinook salmon from the District 1, 2, and 3 commercial and District 4 combined commercial and subsistence catches. For each district, the variance (v) around N_{ijt} (the catch of age class i and run j during period t) was computed for each period t as follows:

$$V[N_{ijt}] = N_t^2 (S_{ijt}^2 \cdot V[P_{it}] + P_{it}^2 \cdot V[S_{ijt}] - V[P_{it}] \cdot V[S_{ijt}])$$

where:

$$V[P_{it}] = \frac{P_{it}(1 - P_{it})}{n_t - 1}$$

P is the proportion of age class i; S is the proportion of run j of age class i harvested during period t; and the variance, $V[S_{ijt}]$ is as derived by Pella and Robertson (1979). Variance around the district catch of ages 1.4 and 1.3 by run, N_j, was computed by summing variances across age classes and periods:

$$V[N_j] = \sum_t^T \sum_i^2 V[N_{ijt}] + 2 \sum_t^T \sum_{i>k}^2 \sum^2 N_t^2 \cdot Cov[P_{it}P_{kt}] \cdot S_{ijt} \cdot S_{kjt}$$

where:

$$Cov[P_{it}P_{kt}] = - \frac{P_{it}P_{kt}}{n_t - 2}$$

T is the total number of fishing periods sampled in each district and n_t is the sample size for the estimate of age composition in period t. Variance around the estimate of total harvest of ages 1.4 and 1.3 fish by run from Districts 1, 2, 3, and 4 estimated from scale pattern analysis was calculated as the sum of the seasonal variances for combined ages across all districts. Total harvest estimates and associated variances by country of origin were calculated by assuming the sum of the lower and middle Yukon to be equal to the Alaskan contribution and the upper Yukon equal to the Canadian contribution. Variance around the estimate of Alaskan contribution, $N_{i(L+M)t}$, was computed by summing variances across runs:

$$S_{iLt} = \text{estimated proportion of lower Yukon run present for age } i \text{ at period } t$$

$$S_{iMt} = \text{estimated proportion of middle Yukon run present for age } i \text{ at period } t$$

$$V[N_{i(L+M)t}] = N_t^2 \{ (S_{iLt} + S_{iMt})^2 \cdot V[P_{it}] + P_{it}^2 \cdot V[S_{iLt} + S_{iMt}] -$$

$$V[P_{it}] \cdot V[S_{iLt} + S_{iMt}] \}$$

where:

$$V[S_{iLt} + S_{iMt}] = V[S_{iLt}] + V[S_{iMt}] - 2\text{Cov}[S_{iLt} S_{iMt}]$$

Differential Age Composition Analysis:

Allocation of the remaining age classes in the District 1, 2, and 3 commercial catches and District 4 combined commercial and subsistence catches were based on differences in escapement age composition in each of the three runs. Escapement age composition data were directly compared by computing ratios for each run whereby the proportion in the escapement of the age class in question was divided by the proportion in the escapement of an age class of known catch composition estimated by scale pattern analysis (either age 1.4 or 1.3):

$$E_{ci} = \text{Proportion of fish of age class } i \text{ in run } c \text{ escapement samples where } i \text{ is an age class of unknown run composition in the catch}$$

$$E_{ca} = \text{Proportion of fish of age class } a \text{ in run } c \text{ where } a \text{ is an age class of known run composition in the catch (either age 1.4 or 1.3)}$$

$$R_{ci} = E_{ci}/E_{ca}$$

Because the relative contribution of age 1.2 fish decreased in escapement samples moving progressively upriver, this age class was compared to age 1.3 fish. All other age classes (2.3, 1.5, 2.4, and 2.5) were compared to age 1.4 fish since the relative contributions of each of these age classes increased in escapement samples moving progressively upriver. These ratios of proportional abundance were then multiplied by the allocated catch of either age 1.3 or 1.4 fish. These computations were summed over all runs to calculate age-specific contribution rates. Multiplication by total catch by age class yields age-specific run contribution estimates:

N_i = Total catch of age group i

N_{ca} = Catch of age group a (where a is either age 1.4 or 1.3) in run c

F_{ci} = Proportion of fish of run c in N_i

$$F_{ci} = \frac{R_{ci} \cdot N_{ca}}{\sum_{j=1}^{3} R_{ji} \cdot N_{ja}}$$

(where j is run number: either 1, 2 or 3 for lower, middle or upper run)

The total harvest of run c for age group i is then:

$$N_{ci} = F_{ci} \cdot N_i$$

Catch Allocation by Fishery:

Estimates of run composition from scale pattern analysis and differential age composition analysis of District 1, 2, and 3 commercial catches were used to allocate the catches of subsistence fisheries in these districts (Figure 4). District 4 catches were divided into two components for purposes of catch allocation: mainstem catches and Koyukuk River subsistence catches. Mainstem catches were allocated to the lower, middle, or upper run based on estimates of run composition from scale pattern analysis and differential age composition analysis of pooled samples from commercial and subsistence gillnet and fishwheel catches. Subsistence catches from the Koyukuk River were taken primarily in the upper portions of the drainage beyond river mile 700 and were assumed to more closely resemble fish of middle Yukon origin. No attempt was made to apportion the Koyukuk River catches by age class.

Catches in Districts 5, 6, and the Yukon Territory were allocated to run based on geography. The entire District 5 harvest was allocated to the upper Yukon run as most of the District 5 catch occurred above the confluence of the Tanana River and there are few documented spawning concentrations between the Tanana River confluence and the Yukon Territory fishery centered in Dawson. The entire District 6 harvest was allocated to the middle Yukon run.

RESULTS AND DISCUSSION

Age Composition

Trends in age composition for the lower, middle, and upper Yukon River escape-
ments (Table 1) were consistent with previous results (McBride and Marshall
1983, Wilcock and McBride 1983, Wilcock 1984, Wilcock 1985). The proportion
of older fish increased in spawning populations moving progressively upriver.
Age 1.4 fish increased in relative abundance from the lower, and middle, to
the upper Yukon (40.8%, and 61.7%, to 69.6%, respectively). Conversely, the
proportion of younger fish (ages 1.2 and 1.3 combined) declined in escapements
moving upriver (56.1% lower, 31.7% middle, and 12.7% upper river). The pro-
portion of age 1.3 fish present was generally low for all escapements. Nearly
all 2-freshwater age fish were found in the upper Yukon escapement (combined
ages 2.3, 2.4, and 2.5 total of 7.8%).

Catch Apportionment

Scale Pattern Analysis:

Scale characters derived from measurements of the initial portion of the first
marine annular zone and the initial portion of the first freshwater annular
zone were generally the most powerful in distinguishing the three runs (Appen-
dix Table 2). Secondarily selected variables were generally derived from the
zone of freshwater plus growth or from the freshwater growth zone as a whole.
This contrasts with previous analyses in which greatest discriminatory power
was generally observed for variables from the zone of freshwater plus growth.
The number of circuli and the width of the first freshwater and first marine
annular zones generally decreased from the lower to upper Yukon runs (Appendix
Table 3). Conversely, number of circuli and width of the freshwater plus
growth zone generally increased from the lower to upper runs.

Mean classification accuracies of the three-way models for age 1.4 and 1.3
fish (Tables 2 and 3) were identical (71.1%). Lower Yukon fish had the high-
est classification accuracies in both models (77.1% and 82.8%, respectively).
Misclassification rates between middle and upper Yukon fish were the highest
(range of 20.5% to 26.1%).

Contribution rates for the three runs were variable (Tables 4 and 5). Con-
trary to results from previous studies, in which either middle or upper or
middle and lower Yukon fish predominated age 1.4 catches, lower and upper
Yukon fish generally predominated both age 1.4 and 1.3 catches throughout 1985.
Differences over time by run were evident for age 1.4 and 1.3 fish from the
lower and upper Yukon (Figures 5 and 6). The contribution of lower Yukon
fish generally increased from the first chinook season period to the pooled
chum season periods in both Districts 1 and 2, while point estimates for upper
Yukon fish tended to decline. Middle Yukon contributions by fishing period
were variable (range of 0% to 58.6%), and did not exhibit clear trends through
time, although a general peak occurred for both age classes during the second
period in both Districts 1 and 2.

Table 1. Age composition summary of Yukon River chinook salmon escapements, 1985.

Location	Aerial Survey Estimate	Sample Size	1981	1980		1979		1978		1977
			1.2	1.3	2.2	1.4	2.3	1.5	2.4	2.5
Lower										
Andreafsky	3,865	445[1]	39.6	12.8	0.0	43.6	0.0	4.0	0.0	0.0
Anvik	1,051	33[2]	30.3	39.4	0.0	30.3	0.0	0.0	0.0	0.0
Total	4,916	478	37.6	18.5	0.0	40.8	0.0	3.1	0.0	0.0
Middle										
Chena	2,553	513	12.1	21.1	0.6	59.2	0.0	7.0	0.0	0.0
Salcha	2,035	511	12.3	17.6	0.0	64.8	0.0	5.1	0.2	0.0
Total	4,588	1,024	12.2	19.5	0.3	61.7	0.0	6.2	0.1	0.0
Upper										
Big Salmon	801	179	1.1	14.5	0.0	63.1	0.6	14.5	5.6	0.6
Little Salmon	89[3]	74	0.0	12.2	0.0	76.9	1.4	5.4	4.1	0.0
Nisutlin	615	77	0.0	5.2	0.0	80.5	1.3	5.2	6.5	1.3
Tatchun	190[4]	12	0.0	25.0	0.0	58.4	0.0	8.3	8.3	0.0
Mainstem Yukon	-[5]	22	0.0	9.1	0.0	54.5	0.0	36.4	0.0	0.0
Total[6]	1,695	364	0.5	12.2	0.0	69.6	0.8	10.0	6.2	0.8

Column group header: Brood Year and Age Group

[1] Includes 21 East Fork beach samples, 115 East Fork carcass samples, and 309 West Fork carcass samples.

[2] Includes 21 carcass samples, 4 beach seine samples, 4 hook and line samples, and 4 gillnet samples.

[3] Incomplete or poor survey conditions resulting in a very minimal count.

[4] Foot survey, Department of Fisheries and Oceans, Canada.

[5] Water turbidity precludes surveys in this area.

[6] Does not include Mainstem Yukon.

Table 2. Classification accuracies of linear discriminant models for age 1.4 Yukon River chinook salmon, 1985.

Actual Region of Origin	Sample Size	Classified Region of Origin		
		Lower	Middle	Upper
Lower	179	0.771	0.196	0.034
Middle	288	0.149	0.646	0.205
Upper	299	0.060	0.224	0.716

Mean Classification Accuracy = 0.711

Variables in the analysis: 106, 67, 29, 61, 70, 100, 14, 1, 88.

Actual Region ot Origin	Sample Size	Classified Region of Origin	
		Lower	Upper
Lower	179	0.899	0.101
Upper	299	0.110	0.890

Mean Classification Accuracy = 0.895

Variables in the analysis: 106, 2, 65, 70, 29, 14.

Table 3. Classification accuracies of linear discriminant models for age 1.3 Yukon River chinook salmon, 1985.

Actual Region of Origin	Sample Size	Classified Region of Origin		
		Lower	Middle	Upper
Lower	58	0.828	0.052	0.121
Middle	157	0.070	0.669	0.261
Upper	58	0.121	0.241	0.638

Mean Classification Accuracy = 0.711

Variables in the analysis: 2, 94, 25, 70, 62, 67, 61.

Actual Region of Origin	Sample Size	Classified Region of Origin	
		Lower	Upper
Lower	58	0.845	0.155
Upper	55	0.127	0.873

Mean Classification Accuracy = 0.859

Variables in the analysis: 67, 9, 100, 109.

Table 4. Run composition estimates for age 1.4 chinook salmon from commercial catches in Yukon River Districts 1, 2, 3, and 4, 1985.

District	Commercial Fishing Period	Dates	Sample Size	Region of Origin	Prop. of Catch	90 Percent Confidence Interval[1]	
						Lower Bound	Upper Bound
1	Preseason[2]	6/15-6/24	146	Lower	0.308	0.176	0.440
				Middle	0.172	-0.031	0.374
				Upper	0.520	0.348	0.691
	1	6/24-6/25	150	Lower	0.370	0.233	0.507
				Middle	0.189	-0.012	0.390
				Upper	0.441	0.277	0.603
	2	6/27-6/28	150	Lower	0.344	0.205	0.482
				Middle	0.329	0.121	0.538
				Upper	0.327	0.167	0.487
	3	7/01-7/02	150	Lower	0.479	0.335	0.623
				Middle	0.070	-0.124	0.264
				Upper	0.451	0.239	0.609
	4-8[3]	7/04-7/19	145	Lower	0.621	0.530	0.712
				Upper	0.379	0.288	0.470
2	1	6/26-6/27	150	Lower	0.199	0.081	0.317
				Middle	0.209	0.004	0.414
				Upper	0.592	0.415	0.769
	2	6/30-7/01	150	Lower	0.150	0.036	0.264
				Middle	0.301	0.090	0.511
				Upper	0.549	0.370	0.728
	4	7/03-7/04	149	Lower	0.412	0.269	0.555
				Middle	0.260	0.055	0.465
				Upper	0.328	0.172	0.484
	3, 5-6[3]	7/02-7/11	77	Lower	0.755	0.549	0.960
				Middle	0.012	-0.241	0.265
				Upper	0.233	0.058	0.408
3	2	7/04-7/05	137	Lower	0.173	0.055	0.291
				Middle	0.155	-0.056	0.367
				Upper	0.672	0.484	0.858
4[4]		7/06-8/22	154[5]	Lower	0.255	0.131	0.379
				Middle	0.209	0.008	0.411
				Upper	0.536	0.365	0.706

[1] Based on Chi-square (2 d.f., a=0.1) of 4.605 for 3 groups, and Chi-square (1 d.f., a=0.1) of 2.716 for 2 groups.
[2] Prior to commercial season. All samples obtained from test fish catches.
[3] Chum salmon season, 6 in (15.2 cm) maximum mesh size.
[4] Pooled commercial and subsistence.
[5] Includes 18 Galena commercial and subsistence fishwheel samples, 111 Galena commercial and subsitence gillnet samples, 12 Stink Creek (Kaltag) testfish fishwheel samples, and 13 Ruby testfish fishwheel samples.

Table 5. Run composition estimates for age 1.3 chinook salmon from commercial catches in Yukon River Districts 1, 2, 3, and 4, 1985.

District	Commercial Fishing Period	Dates	Sample Size	Region of Origin	Prop. of Catch	90 Percent Confidence Interval[1] Lower Bound	Upper Bound
1	1	6/24-6/25	20	Lower	0.611	0.260	0.962
				Middle	0.058	-0.331	0.446
				Upper	0.331	-0.188	0.85
	2	6/27-6/28	15	Lower	0.424	0.045	0.803
				Middle	0.403	-0.155	0.961
				Upper	0.173	-0.422	0.768
	3	7/01-7/02	19	Lower	0.800	0.455	1.144
				Middle	0.036	-0.300	0.373
				Upper	0.164	-0.309	0.636
	4-8[2]	7/04-7/19	90	Lower	0.829	0.687	0.971
				Upper	0.171	0.029	0.313
2	1	6/26-6/27	19	Lower	0.433	0.081	0.786
				Middle	0.120	-0.340	0.581
				Upper	0.447	-0.126	1.019
	2	6/30-7/01	23	Lower	0.302	0.015	0.588
				Middle	0.586	0.100	1.072
				Upper	0.112	-0.385	0.608
	4	7/03-7/04	26	Lower	0.715	0.412	1.016
				Middle	0.202	-0.149	0.553
				Upper	0.083	-0.322	0.489
	3, 5-6[2]	7/02-7/11	54	Lower	0.806	0.580	1.030
				Middle	0.096	-0.133	0.324
				Upper	0.098	-0.202	0.399
3	2	7/04-7/05	26	Lower	0.060	-0.178	0.297
				Middle	0.182	-0.319	0.683
				Upper	0.758	0.185	1.331
4[3]		7/06-8/22	52[4]	Lower	0.412	0.238	0.586
				Upper	0.588	0.414	0.762

[1] Based on Chi-square (2 d.f., a=0.1) of 4.605 for 3 groups, and Chi-square (1 d.f., a=0.1) of 2.716 for 2 groups.
[2] Chum salmon season, 6 in (15.2 cm) maximum mesh size.
[3] Pooled commercial and subsistence.
[4] Includes 19 Galena commercial and subsistence fishwheel samples, 22 Galena commercial and subsitence gillnet samples, 9 Stink Creek (Kaltag) testfish fishwheel samples, and 2 Ruby testfish fishwheel samples.

Figure 5. Run composition estimates and 90% confidence intervals
from scale pattern analysis of age 1.4 chinook salmon,
Yukon River Districts 1 and 2, 1985.

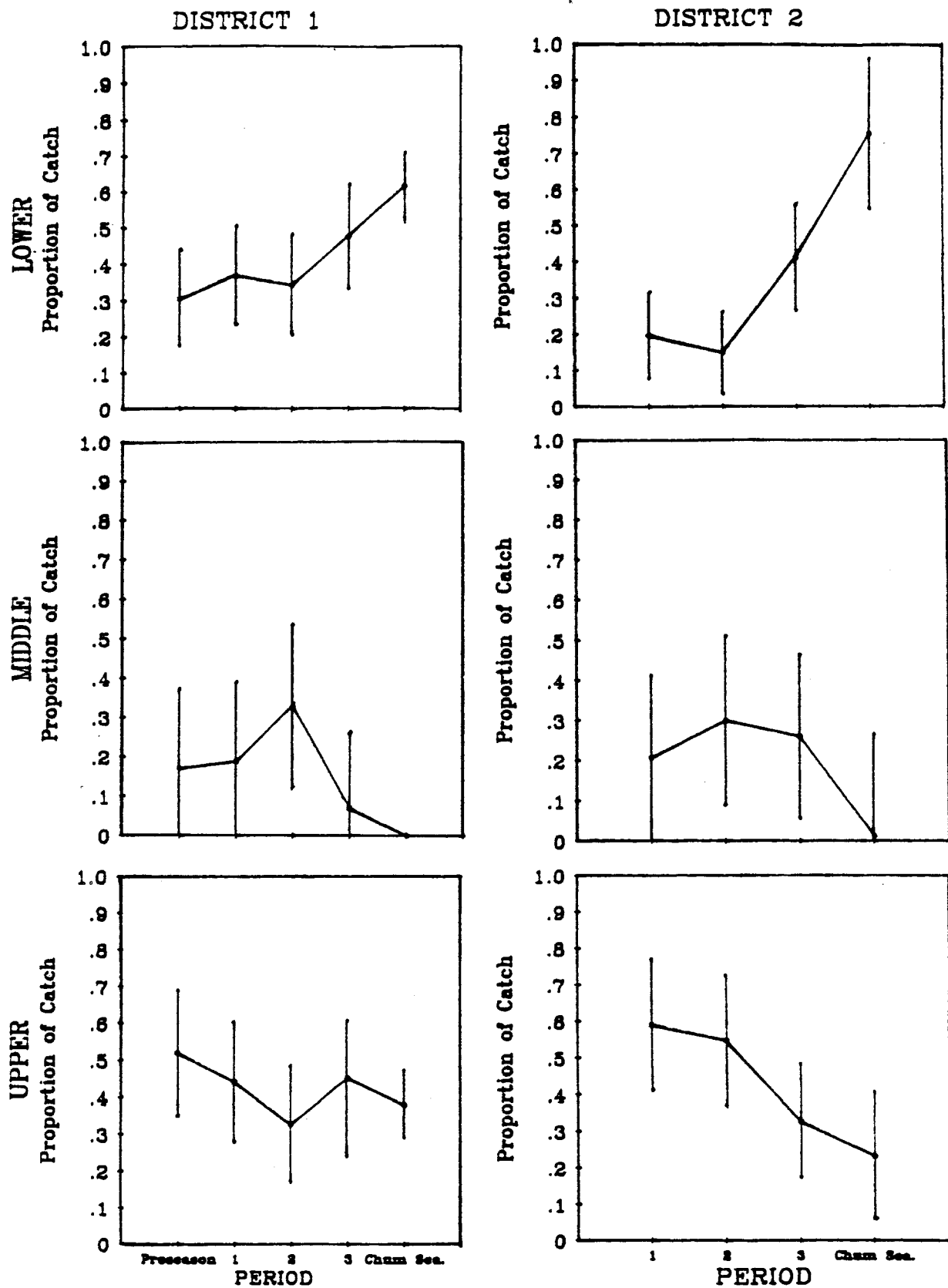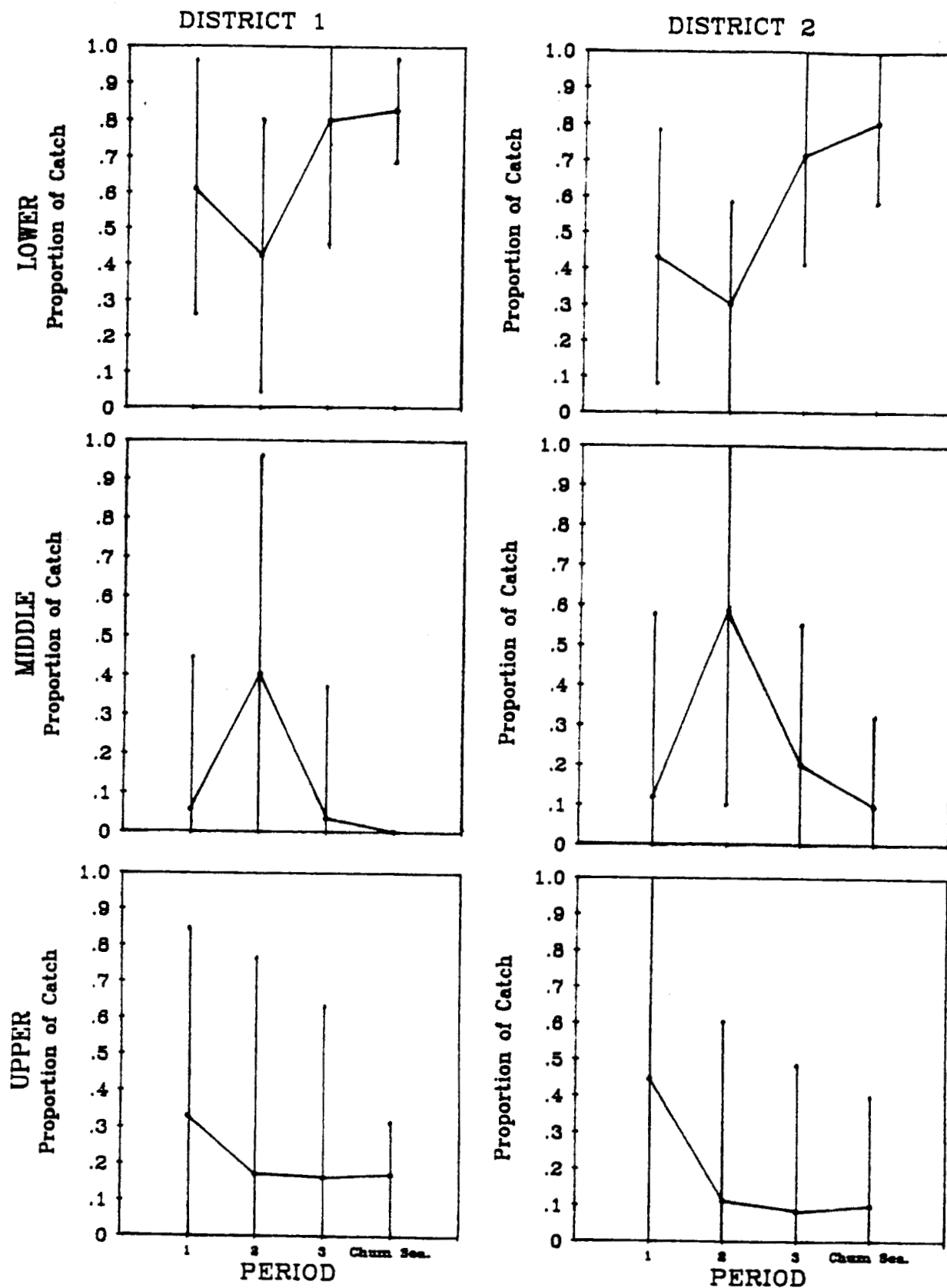Figure 6. Run composition estimates and 90% confidence intervals
from scale pattern analysis of age 1.3 chinook salmon,
Yukon River Districts 1 and 2, 1985.

The age 1.4 catch in District 1 (Table 6) was comprised of nearly equal numbers of fish of lower and upper Yukon origin (28,129 fish or 41.1%, and 26,747 fish or 39.1%, respectively). Catches of middle Yukon fish were smaller (13,609 fish or 19.9%). The age 1.4 catch in District 2 was predominated by fish of upper Yukon origin (15,255 fish or 45.4%).

Age 1.3 catches were comprised primarily of lower Yukon fish. The District 1 harvest of age 1.3 fish was comprised of 67.2% (5,295 fish) lower Yukon, 12.2% (960 fish) middle Yukon, and 20.6% (1,622 fish) upper Yukon fish. Lower Yukon fish also dominated the catch of age 1.3 fish in District 2 (3,574 fish or 61.5%). Middle Yukon fish comprised 26.2% (1,524 fish) of the catch while 12.3% (714 fish) were allocated to the upper Yukon run. Age 1.3 chinook salmon were in low abundance in commercial catches throughout 1985, presumably due to a weak return for this age group. As a result, sample sizes were small for most periods sampled and precision for run composition estimates was generally low.

Scale pattern analysis was applied to the age 1.4 and 1.3 commercial catches from Districts 1, 2, and 3, and commercial and subsistence catches from District 4 to allocated 60.2% (123,287 fish) of the total drainage harvest to run of origin. Of these fish, a total of 74,520 (60.4%) were estimated to be of Alaskan origin (Table 7). Precision of this estimate was high (coefficient of variation 4.5%). Harvest of fish of Canadian origin was estimated at 48,767 fish (39.6%).

An additional 8,421 fish (4.1% of total harvest) from estimated age 1.4 and 1.3 subsistence catches in Districts 1, 2, and 3 were allocated to run of origin by applying proportions estimated from scale pattern analysis of commercial catches in these same districts.

Differential Age Composition Analysis:

Large variations were observed in the contribution rates of the remaining age classes (Table 8) allocated to run of origin using differential age analysis (26,022 fish or 12.7% of total harvest). The majority of the age 1.2 harvests in Districts 1 and 2 were allocated to the lower Yukon run (3,446 fish or 94.2%, and 3,186 fish or 88.1%, respectively). Most age 1.5 fish from District 1 and 2 catches were allocated to the upper Yukon run (4,048 fish or 52.3%, and 2,431 fish or 57.9%, respectively). Upper Yukon fish comprised virtually all of the age 2.3, 2.4, and 2.5 catches.

Commercial catches were composed of similar numbers of lower and upper Yukon fish in both District 1 (39,121 fish or 43.5%, and 34,671 fish or 38.5%, respectively) and District 2 (17,903 fish or 37.0% and 19,496 fish or 40.3%, respectively). Middle Yukon fish were least abundant in both Districts 1 and 2 (16,218 fish or 18.0%, and 10,945 fish or 22.6%, respectively).

Geographic Analysis:

A total of 47,231 fish (23.0% of total harvest) were allocated to run of origin based on geography. District 5 and Yukon Territory commercial and subsistence catches (37,509 fish or 18.3% of total harvest) were assumed to be of

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Table 6. Allocation of age 1.3 and 1.4 chinook salmon catches by run
and fishing period for the commercial fishery in Yukon River
Districts 1 and 2, 1985.

| | District 1 | | | | District 2 | | | | |
Region of Origin	Commercial Fishing Period	Dates	Age Group 1.3	Age Group 1.4	Commercial Fishing Period	Dates	Age Group 1.3	Age Group 1.4	Total Catch
Lower	1	6/24-6/25	1,067	6,878	1	6/26-6/27	169	1,123	9,237
Middle			101	3,514			47	1,180	4,842
Alaska			1,168	10,392			216	2,303	14,079
Upper			578	8,199			175	3,342	12,294
Total			1,746	18,591			391	5,645	26,373
Lower	2	6/27-6/28	857	9,469	2	6/30-7/01	519	2,108	12,953
Middle			814	9,056			1,008	4,230	15,108
Alaska			1,671	18,524			1,527	6,338	28,061
Upper			350	9,001			193	7,715	17,258
Total			2,021	27,525			1,720	14,053	45,319
Lower	3	7/01-7/02	979	7,114	4	7/03-7/04	766	4,152	13,011
Middle			44	1,040			217	2,620	3,920
Alaska			1,023	8,153			983	6,772	16,931
Upper			201	6,698			89	3,305	10,293
Total			1,224	14,851			1,072	10,077	27,224
Lower	4-12[1]	7/04-8/13	2,392	4,669	3,5-13	7/02-8/22	2,119	2,894	12,074
Middle			0	0			252	46	298
Alaska			2,392	4,669			2,371	2,940	12,372
Upper			494	2,849			258	893	4,494
Total			2,886	7,518			2,629	3,833	16,866
Lower		6/24-8/13	5,295	28,129		6/26-8/22	3,574	10,277	47,275
Middle			960	13,609			1,524	8,076	24,168
Alaska			6,255	41,738			5,098	18,353	71,444
Upper			1,622	26,747			714	15,255	44,338
Total			7,877	68,485			5,812	33,608	115,782

[1] Chum salmon season, 6 in (15.2 cm) maximum mesh size.

Table 7. Total commercial harvest of age 1.3 and 1.4 chinook salmon by nation of origin estimated from scale pattern analysis for Yukon River Districts 1, 2, 3, and 4, 1985.

Region of Origin	Number of Fish	90 Percent Confidence Interval		Coefficient of Variation [1]
		Lower Bound	Upper Bound	
Alaska	74,520	66,427	82,613	4.5%
Canada	48,767	40,316	56,818	6.8%
Total	123,287			

[1] Coefficient expressed as a percentage.

Table 8. Allocation by age class and region of origin of chinook salmon from Yukon River Districts 1, 2, 3, 4, 5, 6, and Yukon Territory commercial and subsistence catches, 1985.

District	Fishery	Commercial Fishing Dates	Region of Origin	1982 1.1	1981 1.2	1980 0.4	1980 1.3	1980 2.2	1979 1.4	1979 2.3	1978 1.5	1978 2.4	1977 2.5	Total
1	Commercial Gillnet	6/24-8/13	Lower	0	3,446	0	5,295	0	28,129	0	2,251	0	0	39,121
			Middle	0	192	0	960	0	13,609	0	1,441	16	0	16,218
			Alaska Total	0	3,639	0	6,255	0	41,738	0	3,692	16	0	55,339
			Upper	0	21	0	1,622	0	26,747	118	4,048	1,731	384	34,671
			Total	0	3,660	0	7,877	0	68,485	118	7,740	1,747	384	90,011
	Subsistence Gillnet[1]		Lower	0	118	0	181	0	960	0	77	0	0	1,335
			Middle	0	7	0	33	0	464	0	49	1	0	553
			Alaska Total	0	124	0	214	0	1,424	0	126	1	0	1,889
			Upper	0	1	0	55	0	913	4	138	59	13	1,183
			Total	0	125	0	269	0	2,337	4	264	60	13	3,071
2	Commercial Gillnet	6/26-8/22	Lower	0	3,186	0	3,574	0	10,277	0	866	0	0	17,903
			Middle	0	418	0	1,524	18	8,076	0	900	9	0	10,945
			Alaska Total	0	3,604	0	5,098	18	18,353	0	1,767	9	0	28,849
			Upper	0	13	0	714	0	15,255	102	2,431	926	55	19,496
			Total	0	3,617	20	5,812	18	33,608	102	4,198	935	55	48,365
	Subsistence Gillnet[2]		Lower	0	228	0	256	0	737	0	62	0	0	1,284
			Middle	0	30	0	109	1	579	0	65	1	0	785
			Alaska Total	0	258	0	366	1	1,316	0	127	1	0	2,068
			Upper	0	1	0	51	0	1,094	7	174	66	4	1,398
			Total	0	259	1	417	1	2,410	7	301	67	4	3,468
3	Commercial Gillnet	7/01-8/13	Lower	0	19	0	17	0	352	0	15	0	0	403
			Middle	0	17	0	50	0	316	0	18	0	0	401
			Alaska Total	0	36	0	67	0	668	0	33	0	0	804
			Upper	0	5	0	210	0	1,369	16	109	67	8	1,784
			Total	0	41	0	277	0	2,037	16	142	67	8	2,588
	Subsistence Gillnet[3]		Lower	0	25	0	22	0	454	0	19	0	0	521
			Middle	0	22	0	65	0	408	0	23	0	0	518
			Alaska Total	0	47	0	86	0	863	0	43	0	0	1,039
			Upper	0	6	0	271	0	1,768	20	141	87	10	2,303
			Total	0	53	0	358	0	2,630	20	184	87	10	3,342
4	[4]	6/30-9/06	Lower	0	1,184	0	539	0	990	0	68	0	0	2,781
			Middle	0	0	0	0	0	811	0	74	0	0	2,090 [5]
			Alaska Total	0	1,184	0	539	0	1,801	0	142	0	0	4,871
			Upper	0	34	0	769	0	2,081	21	271	21	0	3,197
			Total	21	1,218	0	1,308	0	3,882	21	413	21	0	8,089 [6]
5	[4]	7/09-8/12	Upper	0	1,314	0	4,405	130	9,827	370	1,777	685	0	18,508 [7]
6	Commercial[8]	7/15-8/11	Middle	16	232	0	531	0	347	0	16	0	0	1,142
	Subsistence[8,9]		Middle	103	1,497	0	3,429	0	2,242	0	103	0	0	7,375
Yukon Territory	Commercial Gillnet	7/21-9/14	Upper	0	25	0	1,295	0	8,223	63	2,590	289	88	12,573
	Subsistence[10] Gillnet		Upper	0	13	0	662	0	4,204	32	1,324	148	45	6,428
TOTAL HARVEST			Lower	0	8,206	0	9,884	0	41,899	0	3,359	0	0	63,348
			Middle	119	2,416	0	6,701	19	26,853	0	2,689	26	0	40,028 [11]
			Alaska Total	119	10,622	0	16,585	19	68,752	0	6,048	26	0	103,376
			Upper	0	1,433	0	10,055	130	71,480	754	13,004	4,079	607	101,542
			Total	140	12,055	21	26,640	149	140,232	754	19,052	4,105	607	204,960

1 Allocation based on season total District 1 commercial catch samples.
2 Allocation based on season total District 2 commercial catch samples.
3 Allocation based on District 3 commercial catch samples.
4 Combined commercial and subsistence, fishwheel and gillnet.
5 Includes Koyukuk River subsistence catch (1,205 fish) not apportioned by age class.
6 Commercial catch = 664. Subsistence catch = 7,425.
7 Commercial catch = 3,418. Subsistence catch = 15,090.
8 Combined fishwheel and gillnet.
9 Age apportionment based on District 6 commercial catch samples.
10 Age apportionment based on Yukon Territory commercial catch samples.
11 Includes District 4 catches allocated to middle Yukon run but not apportioned by age class.

upper Yukon origin. Commercial and subsistence catches in District 6 and subsistence catches from the upper Koyukuk River in District 4, allocated entirely to the middle Yukon run, totaled 9,722 fish or 4.7% of total drainage harvest.

Total Harvest:

Based on the findings of the scale pattern analysis of age 1.4 and 1.3 fish, the differential age composition allocation of the remaining age classes, and the assumptions concerning unsampled fisheries, the commercial and subsistence fishery catches of chinook salmon from the entire Yukon River drainage were allocated to run of origin (Table 8). Upper Yukon River fish comprised the largest single run component and contributed 101,542 fish or 49.5% of the total drainage harvest. Lower Yukon fish were next in abundance at 63,348 fish (30.9%). The contribution of 40,028 fish from the middle Yukon run comprised only 19.5% of the total harvest.

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APPENDICES

Appendix Table 1.   Scale variables screened for linear discriminant function analysis of ages 1.3 and 1.4 Yukon River chinook salmon.

Variable	1st Freshwater Annular Zone
1	Number of circuli (NC1FW)[1]
2	Width of zone (S1FW)[2]
3 (16)	Distance, scale focus (C0) to circulus 2 (C2)
4	Distance, C0-C4
5 (18)	Distance, C0-C6
6	Distance, C0-C8
7 (20)	Distance, C2-C4
8	Distance, C2-C6
9 (22)	Distance, C2-C8
10	Distance, C4-C6
11 (24)	Distance, C4-C8
12	Distance, C(NC1FW -4) to end of zone
13 (26)	Distance, C(NC1FW -2) to end of zone
14	Distance, C2 to end of zone
15	Distance, C4 to end of zone
16-26	Relative widths, (variables 3-13)/S1FW
27	Average interval between circuli, S1FW/NC1FW
28	Number of circuli in first 3/4 of zone
29	Maximum distance between 2 consecutive circuli
30	Relative width, (variable 29)/S1FW

Variable	Freshwater Plus Growth
61	Number of circuli (NCPG)[3]
62	Width of zone (SPGZ)[4]

Variable	All Freshwater Zones
65	Total number of freshwater circuli (NC1FW+NCPG)
66	Total width of freshwater zone (S1FW+SPGZ)
67	Relative width, S1FW/(S1FW+SPGZ)

-(Continued)-

Appendix Table   1.   Scale variables screened for linear discriminant
                      function analysis of ages 1.3 and 1.4 Yukon River
                      chinook salmon (continued).

Variable	1st Marine Annular Zone
70	Number of circuli (NC1OZ)[5]
71	Width of zone (S1OZ)[6]
72 (90)	Distance, end of freshwater growth (EFW) to C3
73	Distance, EFW-C6
74 (92)	Distance, EFW-C9
75	Distance, EFW-C12
76 (94)	Distance, EFW-C15
77	Distance, C3-C6
78 (96)	Distance, C3-C9
79	Distance, C3-C12
80 (98)	Distance, C3-C15
81	Distance, C6-C9
82 (100)	Distance, C6-C12
83	Distance, C6-C15
84 (102)	Distance, C9-C15
85	Distance, C(NC1OZ -6) to end of zone
86 (104)	Distance, C(NC1OZ -3) to end of zone
87	Distance, C3 to end of zone
88	Distance, C9 to end of zone
89	Distance, C15 to end of zone
90-104	Relative widths, (variables 72-86)/S1OZ
105	Average interval between circuli, S1OZ/NC1OZ
106	Number of circuli in first 1/2 of zone
107	Maximum distance between 2 consecutive circuli
108	Relative width, (variable 107)/S1OZ

Variable	All Marine Zones
109	Width of 2nd marine zone, (S2OZ)
110	Width of 2nd marine zone, (S3OZ)
111	Total width of marine zones (S1OZ+S2OZ+S3OZ)
112	Relative width, S1OZ/(S1OZ+S2OZ+S3OZ)
113	Relative width, S2OZ/(S1OZ+S2OZ+S3OZ)

[1] Number of circuli, 1st freshwater zone.
[2] Size (width) 1st freshwater zone.
[3] Number of circuli, plus growth zone.
[4] Size (width) plus growth zone.
[5] Number of circuli, 1st ocean zone.
[6] Size (width) 1st ocean zone.

Appendix Table 2. Group means, standard errors, and one-way analysis of variance F-test for scale variables selected for use in linear discriminant models of age 1.4 and 1.3 Yukon River chinook salmon, 1985.

Age Growth Zone	Variable	Lower		Middle		Upper		F-Value
		Mean	S.E.	Mean	S.E.	Mean	S.E.	
1.4 1st FW Annular	1	10.98	0.138	9.97	0.087	10.75	0.109	23.463
	2	133.62	1.363	118.45	0.975	121.01	1.095	42.595
	14	81.86	1.272	67.27	0.839	71.31	1.004	29.000
	29	170.45	0.238	16.22	0.162	14.52	0.156	50.536
FW Plus Growth	61	3.58	0.096	4.98	0.058	5.16	0.109	73.002
Total FW Growth	65	14.56	0.134	14.94	0.093	15.91	0.125	34.339
	67	0.793	0.005	0.695	0.003	0.703	0.006	99.268
1st Ocean Annular	70	28.07	0.170	26.64	0.133	24.66	0.166	109.696
	88	368.65	3.358	334.44	2.552	287.30	3.162	137.603
	100	0.205	0.002	0.228	0.002	0.264	0.003	166.324
	106	14.61	0.100	13.57	0.079	12.10	0.095	175.191
1.3 1st FW Annular	2	136.36	2.375	102.27	1.361	112.28	2.253	82.285
	9	57.02	0.988	47.76	0.665	48.07	0.907	34.022
	14	86.21	2.320	55.31	1.237	63.16	1.944	80.560
	25	0.210	0.005	0.289	0.004	0.240	0.006	72.529
FW Plus Growth	61	3.67	0.221	5.25	0.100	5.71	0.210	34.443
	62	35.74	2.322	51.19	1.071	56.55	2.304	30.324
Total FW Growth	67	0.797	0.011	0.668	0.005	0.669	0.011	68.538
1st Ocean Annular	70	25.72	0.366	24.95	0.184	23.72	0.340	9.739
	94	0.563	0.011	0.596	0.006	0.655	0.012	17.734
	100	0.240	0.006	0.259	0.003	0.292	0.006	19.330

Appendix Table 3. Group means, standard errors, and one-way analysis of variance F-test for the number of circuli and incremental distance of salmon scale growth zone measurements from age 1.4 and 1.3 Yukon River chinook salmon, 1985.

Age	Growth Zone	Variable	Lower Mean	Lower S.E.	Middle Mean	Middle S.E.	Upper Mean	Upper S.E.	F-Value
1.4	1st FW Annular	No. Circ.	10.98	0.14	9.97	0.09	10.75	0.11	23.463
		Incr. Dist.	133.62	1.36	118.45	0.98	121.01	1.10	42.595
	FW Plus Growth	No. Circ.	3.58	0.10	4.98	0.06	5.16	0.11	73.002
		Incr. Dist.	34.90	0.96	52.14	0.67	52.13	1.17	82.421
	1st Ocean Annular	No. Circ.	28.07	0.17	26.64	0.13	24.66	0.17	109.696
		Incr. Dist.	493.69	3.58	476.79	2.66	435.71	3.06	92.603
	2nd Ocean Annular	Incr. Dist.	336.57	4.67	345.47	3.87	347.82	4.05	3.971
	3rd Ocean Annular	Incr. Dist.	412.86	4.24	389.08	2.89	378.68	3.05	24.101
1.3	1st FW Annular	No. Circ.	12.09	0.26	9.01	0.13	10.24	0.23	67.518
		Incr. Dist.	136.36	2.38	102.27	1.36	112.28	2.25	82.285
	FW Plus Growth	No. Circ.	3.67	0.22	5.25	0.10	5.71	0.21	34.443
		Incr. Dist.	35.74	2.32	51.19	1.07	56.55	2.30	30.324
	1st Ocean Annular	No. Circ.	25.72	0.37	24.95	0.18	23.72	0.34	9.739
		Incr. Dist.	452.48	6.46	426.05	3.95	416.57	6.35	8.725
	2nd Ocean Annular	Incr. Dist.	452.64	7.68	405.43	5.88	398.91	9.23	11.367